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IGNITION OF GAS BY MINIATURE ELECTRIC LAMPS WITH TUNGSTEN FILAMENTS

BY

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IGNITION OF GAS BY MINIATURE ELECTRIC LAMPS WITH TUNGSTEN FILAMENTS.

By H. H. Clark.

INTRODUCTION.

The Bureau of Mines has been asked a number of times whether fire damp can be ignited by breaking the bulb of a miniature incandescent lamp in a body of it.

This question is of more importance now than at any previous time because of the increasing use of portable electric lamps. The development of the tungsten filament has given a fresh impetus to the manufacture of such lamps, and there are now upon the market several types especially designed for mine service. Portable electric lamps are often used where gas is known to be present, and sometimes, as in rescue work, such lamps must be used where gas (methane) may be present in dangerous amounts.

In connection with its investigations of mine accidents and the dangers attending the use of electricity underground, the Bureau of Mines at its experiment station in Pittsburgh, Pa., has undertaken the study of various matters relating to the ignition of fire damp by electrical equipment. The tests described below were made upon miniature incandescent-lamp bulbs and were preliminary to more extensive tests which the bureau plans to make upon complete portable lamp equipments.

Because of the importance of the question put to the bureau and because of the interest that has been manifested, the following brief review of the test results is published in advance of a more detailed description of the investigation, which will appear in another report.

REVIEW OF TESTS.

BULBS TESTED.

The tests were made with miniature incandescent-lamp bulbs containing tungsten filaments. The bulbs were supplied to the bureau without cost by the General Electric Co., the Federal Miniature Lamp Co., and the National Electric Lamp Association.

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CONDITIONS OF TEST.

In all tests the filaments were glowing at the moment when the bulbs were broken. One hundred and thirty-one bulbs were broken in a mixture of natural gas (that used in Pittsburgh) and air combined in the proportion of 8.6 per cent gas to 91.4 per cent air. These percentages of the gas and air form the most explosive mixture.

Forty-five tests were made in gas-and-air mixtures other than the most explosive. These mixtures contained from 3 per cent to 12.4 per cent of gas. Mixtures containing as little as 5 per cent of gas and others containing as much as 12.4 per cent of gas were ignited by 1.5-candlepower, 3.5-volt, 0.3-ampere bulbs that were smashed while burning at rated voltage.

TABULATION OF RESULTS.

TABLE 1.—*Bulbs causing ignition at or below rated voltage.*

Manufacturer's rating.			Number of tests.	Number of ignitions.	Percentage of rated voltage causing ignition.[a]
C. P.	*Volts.*	*Amperes.*			
1.0	2.5	0.3	11	7	100.0
1.5	3.5	.3	23	16	100.0
2.0	5.5	.3	9	6	98.7
1.0	2.0	.....	9	7	100.0
1.0	2.5	.....	10	3	100.0
2.0	4.0	.....	10	7	82.2
2.0	4.5	.....	10	7	85.3
.....	2.0	.73	5	3	94.5
.....	4.0	.53	5	5	94.9
.....	6.0	.30	5	5	88.2

TABLE 2.—*Bulbs causing ignition at more than rated voltage.*

Manufacturer's rating.			Number of tests.	Number of ignitions.	Percentage of rated voltage causing ignition.[a]
C. P.	*Volts.*	*Amperes.*			
0.5	1.5	0.4	10	1	132.7
.....	2.0	.23	9	3	120.0
.....	2.0	.40	9	3	106.0
.....	2.0	.53	6	5	102.0

[a] The values given in this column are the average percentages of the voltages impressed upon such bulbs as caused ignition.

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PUBLICATIONS ON MINE ACCIDENTS AND TESTS OF EXPLOSIVES.

The following Bureau of Mines publications may be obtained free by applying to the Director, Bureau of Mines, Washington, D. C.:

BULLETIN 10. The use of permissible explosives, by J. J. Rutledge and Clarence Hall. 1912. 34 pp., 5 pls.

BULLETIN 15. Investigations of explosives used in coal mines, by Clarence Hall, W. O. Snelling, and S. P. Howell, with a chapter on the natural gas used at Pittsburgh, by G. A. Burrell, and an introduction by C. E. Munroe. 1911. 197 pp., 7 pls.

BULLETIN 17. A primer on explosives for coal miners, by C. E. Munroe and Clarence Hall. 61 pp., 10 pls. Reprint of United States Geological Survey Bulletin 423.

BULLETIN 20. The explosibility of coal dust, by G. S. Rice, with chapters by J. C. W. Frazer, Axel Larsen, Frank Haas, and Carl Scholz. 204 pp., 14 pls. Reprint of United States Geological Survey Bulletin 425.

BULLETIN 26. Notes on explosive mine gases and dusts, by R. T. Chamberlin. 67 pp. Reprint of United States Geological Survey Bulletin 383.

TECHNICAL PAPER 4. The electrical section of the Bureau of Mines, its purpose and equipment, by H. H. Clark. 1911. 12 pp.

TECHNICAL PAPER 6. The rate of burning of fuse as influenced by temperature and pressure, by W. O. Snelling and W. C. Cope. 1912. 28 pp.

TECHNICAL PAPER 7. Investigations of fuse and miners' squibs, by Clarence Hall and S. P. Howell. 1912. 19 pp.

TECHNICAL PAPER 11. The use of mice and birds for detecting carbon monoxide after mine fires and explosions, by G. A. Burrell. 1912. 15 pp.

TECHNICAL PAPER 12. The behavior of nitroglycerin when heated, by W. O. Snelling and C. G. Storm. 1912. 14 pp., 1 pl.

TECHNICAL PAPER 13. Gas analysis as an aid in fighting mine fires, by G. A. Burrell and F. M. Seibert. 1912. 16 pp.

TECHNICAL PAPER 19. The factor of safety in mine electrical installations, by H. H. Clark. 1912. 14 pp.

MINERS' CIRCULAR 2. Permissible explosives tested prior to January 1, 1911, and precautions to be taken in their use, by Clarence Hall. 1911. 12 pp.

MINERS' CIRCULAR 3. Coal-dust explosions, by G. S. Rice. 1911. 22 pp.

MINERS' CIRCULAR 4. The use and care of mine-rescue breathing apparatus, by J. W. Paul. 1911. 24 pp.

MINERS' CIRCULAR 5. Electrical accidents in mines, their causes and prevention, by H. H. Clark. 1911. 10 pp., 3 pls.

MINERS' CIRCULAR 6. Permissible explosives tested prior to January 1, 1912, and precautions to be observed in their use, by Clarence Hall. 1912. 20 pp.

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